RADIATION PROTECTION PROGRAM (RPP)

The Radiation Protection Program (RPP) applies to the Ames Laboratory activities involving the use of radioactive material, radiation emitting devices, mitigation of legacy radiological contamination, and safety aspects of the possession, use, and disposition of sources of ionizing radiation.

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1.0 APPROVAL RECORD

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2.0 REVISION/REVIEW INFORMATION

The revision description for this document is available from and maintained by the author.

3.0 SUMMARY

The Radiation Protection Program (RPP) applies to the Ames Laboratory activities described in the following sections that involve the use of radioactive material, radiation emitting devices, and mitigation of legacy radiological contamination. The elements described in the RPP are fully implemented within the current funding of the Laboratory. No new radiological activities are anticipated that vary significantly from current activities and the RPP is not anticipated to significantly impact non-radiological activities at the Laboratory.

The RPP contains a description of the Ames Laboratory's practices and demonstrates that the Laboratory is in compliance with the applicable regulations and requirements of 10 CFR 835 including its standards and definitions. The primary Ames Laboratory organizational units involved with radiation safety include: the ALARA committee, the Environment, Safety, Health and Assurance (ESH&A) office [and the Health Physics group (HPG) and the Radiation Safety Officer (RSO)], and line management. The use of sources of ionizing radiation is authorized by the ALARA committee and Laboratory's readiness review process. Internal audits are performed, often in conjunction with reviews conducted by the DOE Ames Site Office and the Ames Laboratory Internal Audit Office.

The external dose monitoring program at Ames Laboratory is adequate to demonstrate compliance with the established dose limits and is based on a dosimetry provider's accreditation equivalent with the National Voluntary Laboratory Accreditation Program for Personnel Dosimetry. Ames Laboratory is not required to have DOELAP accreditation and has been given an exception from DOE. Ames Laboratory does not use planned special exposures. Occupational exposures, as a result of the use of sources of ionizing radiation, are consistently well below the established limits set forth in 10 CFR 835. The amount of special nuclear materials in inventory at Ames Laboratory is well below the quantities of fissile material to potentially constitute a critical mass, therefore exposure of personnel to radiation from a nuclear criticality accident is not possible and personnel are not provided nuclear accident dosimetry.

4.0 SCOPE of RADIOLOGICAL OPERATIONS (Subpart A, Subpart B)

Ames Laboratory is a government-owned, contractor-operated research facility of the U.S. Department of Energy; Iowa State University is the contractor. The mission of the Laboratory is to create materials, inspire minds to solve problems, and to address global challenges.

The RPP constitutes Ames Laboratory's implementation plan for the requirements of 10 CFR Part 835, *Occupational Radiation Protection*. The RPP will be updated and submitted to the Department of Energy (DOE) on the occasion that the following conditions are met: whenever a change or an addition to the RPP is made, prior to the initiation of a task not within the scope of the RPP, and within 180 days of the effective date of an modification to 10 CFR 835. The RPP can be changed, added to, or updated without DOE approval if the changes do not decrease the effectiveness of the RPP and the RPP, as changed, continues to meet the requirements of 10 CFR 835. Proposed changes that decrease the effectiveness of the RPP will not be implemented without submittal to and approval by DOE. Updates to the RPP will be considered approved by DOE in accordance with 10 CFR 835.101(i).

Ames Laboratory performs a limited number of research activities that use small quantities of radioactive materials, radiation produced by x-ray systems and/or emitted by sealed radioactive material. Three general categories of ionizing radiation sources are used:

I. Small quantities of source and special nuclear materials (i.e., thorium, uranium, depleted uranium, and low enriched uranium) are utilized by a very limited number of research activities. The source materials and special nuclear materials are maintained in individual materials balance areas and reported quarterly to DOE through the Nuclear Materials Management and Safeguards System (NMMSS). The Laboratory is considered a category IV facility for purposes of the Materials Control and Accountability program. Research involving the use of these materials, includes such projects as purification of isotopes for use at other research facilities, nebulization of materials and the study of laser-ablated materials. Periodic requests are received from other facilities for small quantities of purified material, (e.g., crystal bar thorium) which are sent as limited quantity shipments.

II. Sealed and unsealed radioactive materials are used as check sources and calibration sources or are specifically ordered for use in short-term research projects. Some research may involve the use of small, low activity neutron-activated metal sources.

III. Radiation generating devices (RGD) are utilized by several research groups. Sealed sources are used for gamma radiation capture for research sample analysis.

Areas of low-level legacy contamination exist in some buildings of the Laboratory as a result of DOE legacy research and production activities. These areas are not routinely accessed by employees and signs are posted at access points to these areas. Work in the contaminated area is performed under authority of established radiological work permits and HPG oversight. New activities or modifications to approved activities involving the use of any source of ionizing radiation must be approved through the Ames Laboratory *Readiness Review Procedure* (Procedure 10200.010) before beginning operations.

5.0 As LOW AS REASONABLY ACHIEVABLE (ALARA) (Subpart B, Subpart K)

ALARA (Policy 10202.001) is Ames Laboratory's approach to radiological protection, and it is used to manage and control exposures (individual and collective) to employees, visitors, and the general public. ALARA is not a dose limit, but is a philosophy for devising processes, procedures and operations to maintain doses within applicable limits and as far below them as can be reasonably achieved. An ALARA committee has been established by the *ALARA Committee Charter* (Charter 10202.001), to make recommendations regarding the safety aspects of the possession, use, and disposition of sources of ionizing radiation by Ames Laboratory to ensure that radiation exposures and releases are *ALARA*.

Ames Laboratory's policies and procedures are consistent with the ALARA philosophy. It is the policy of Ames Laboratory to conduct its activities in such a manner that worker and public safety, as well as protection of the environment, is given high priority. Ames Laboratory management is committed to maintaining ionizing radiation risks to levels that are ALARA and to minimizing associated environmental, safety and health impacts in all activates. Both individual and collective exposures to laboratory workers, visitors, or members of the public, are maintained within appropriate regulatory limits and as far below such limits as social, technical, economic, practical, and public policy considerations permit.

6.0 AUTHORIZATION PROCESS (Subpart B)

The ALARA Committee and Safety Review Committee (SRC) must specifically authorize the use of sources of ionizing radiation. All research activities are subject to the *Readiness Review Procedure* (Procedure 10200.010). Readiness review forms and the *Application for Use of Radioactive Materials* form (Form 10202.003), are submitted to the ESH&A office for review. The RSO may require additional information from the applicant. If the forms are completed adequately, the RSO signs the application form. The application form and the readiness review forms are then forwarded to the ALARA Committee chair. The chair, in consult with the RSO, decides whether authorization is to be granted and documents approval on the application. The readiness review information is then reviewed and sent for final approval by the SRC.

7.0 MANAGEMENT AND ADMINISTRATIVE CONTROLS (Subpart B)

It is the policy of Ames Laboratory to both allow and facilitate the use of radioactive materials and radiation generating devices for purposes of research and teaching. At the same time, Ames Laboratory is committed to ensuring that all uses of these materials and devices are in compliance with regulatory requirements and that resultant radiation exposures are kept ALARA. Toward this end, the Ames Laboratory has established specific administrative documents and an organizational structure with responsibilities for controlling the use of radioactive materials and radiation generating devices. The primary organizational units involved with radiation safety include the ALARA committee, the Environment, Safety, Health and Assurance (ESH&A) office with its Health Physics group (HPG) and the Radiation Safety Officer (RSO), and line management.

7.1 ALARA Committee (Subpart B 835.101(c), Subpart K)

An ALARA committee, consisting of members of Ames Laboratory's staff and ISU faculty appointed by the Ames Laboratory Director is a sub-committee of the Safety Review Committee (SRC) and the governing body for ionizing radiation

protection within the Ames Laboratory. The ALARA committee's purpose is to make recommendations regarding the safety aspects of the possession, use, and disposition of sources of ionizing radiation by Ames Laboratory to ensure that radiation exposures and releases are *ALARA*.

7.2 ESH&A, the HPG, and the RSO (Subpart B 835.103, Subpart C 835.209, Subpart D 835.401 Subpart L)

The RPP is administered through the Health Physics group (HPG) of the Environment, Safety, Health and Assurance (ESH&A) office. The ESH&A office has the responsibility for managing health and safety programs including radiation, chemical, industrial hygiene, general safety, biological safety and specific RPP responsibilities including: use of radioactive materials and radiation generating devices, sealed radioactive sources, personnel training, laboratory surveys and inspections, waste handling, management of legacy contamination projects, and personnel dosimetry. The Ames Laboratory *Integrated Safety Management System (ISMS) and Worker Safety and Health Program Description* (Plan 10200.016), and the *ESH&A Program Manual* (Manual 10200.002) document the primary elements of the Ames Laboratory's safety program.

The Laboratory's radiation safety officer (RSO) is a trained and experienced individual who has the responsibility for the day-to-day administration and oversight of Ames Laboratory's Radiation Protection Program. The RSO is also a permanent member of the ALARA committee. The HPG consists of the RSO assisted by trained and experienced Radiological Control Technicians (RCTs), who together ensure the safety aspects of the possession, use, and disposition of sources of ionizing radiation.

The HPG works closely with Facilities and Engineering Services (F&ES) regarding radiation control of legacy contamination issues throughout the Laboratory's facilities. HPG closely monitors radiation conditions covering; air monitoring, contamination monitoring and control in support of general facilities work as well as demolition and remodeling jobs. The *Control of Radioactive Contamination* procedure (Procedure 10202.008) provides a methodology for establishing and implementing a contamination control and measurement program. Alternate methods that are demonstrated to provide an equivalent or better level of protection are acceptable. Ames Laboratory's contamination control program incorporates three types of control: (1) design control, (2) engineering control, and (3) administrative control. The *Workplace Air Monitoring* (Procedure 10202.021) presents the basis for establishing and operating a workplace air monitoring program and addresses requirements for monitoring of individuals and areas. It includes air monitoring guidance to demonstrate compliance to 10 CFR 835 and requires monitoring of airborne radioactivity:

- Where an individual is likely to receive an exposure of 40 or more DAC-hours in a year (an intake equivalent to 0.1 rem/year) ; or
- As necessary to characterize the airborne radioactivity hazard where respiratory protection devices have been prescribed, and
- As necessary to provide warning of increased airborne radioactivity concentrations that warrant immediate action

The HPG maintains the Laboratory's radiation detection capabilities and instrumentation. A *Health Physics Counting Room SOP* (Procedure 10202.053) provides step-by-step instructions for the daily use of the HPG counting room instruments, and the *Gas Proportional Instrument Calibration* procedure (Procedure 10202.056) provides guidance for calibrating the gas proportional radiation detection instruments. *Calibration of Portable Survey Instruments* (Procedure 10202.011) describes the requirements for calibration of Ames Laboratory portable radiation survey instruments being sent out for calibration. It requires the inspection and maintenance of instruments and then the use of NIST traceable standards for annual calibration.

Internal audits of all functional elements of the radiation protection program are conducted no less frequently than every 36 months and shall include program content and implementation. The audits may be performed in conjunction with reviews conducted by the DOE Ames Site Office and the Ames Laboratory Internal Audit Office.

7.3 Line Management

Ames Laboratory Management support and commitment to limit radiation doses to employees, visitors, the public, and the environment to those levels that are as low as reasonably achievable are affirmed by *ALARA* (Policy 10202.001), *ALARA Committee Charter* (Charter 10202.001), and *ALARA Procedures* (Procedure 10202.001). The individuals authorized by the ALARA committee and ultimately the SRC as activity supervisors for activities involving the use of radioactive material or a radiation generating device are responsible for actions conducted under the scope of that authorization.

8.0 RADIATION SAFETY TRAINING (Subpart J)

Individuals who work with sources of ionizing radiation are provided with appropriate training commensurate to the hazards prior to beginning work with radioactive materials or devices that contain, emit and/or generate radiation. At Ames Laboratory, several forms of general and specialized training are provided as defined in the *ESH&A Program Manual* (Manual 10200.002) in order to ensure that individuals have sufficient knowledge to conduct their work safely. Courses are modified and provided to individuals when there are significant changes to the radiation protection practices that may affect the individual. Retrain cycles are every 24 months. Specialized training includes the following.

Radiological Worker I – Rad Worker Training for Support Staff (AL-162)

F&ES staff who work in known or suspected contamination areas are required to have a basic understanding of radiation, its hazards, and how to prevent the spread of contamination. HPG provides oversight to craftsmen working is areas of suspected contamination. Radiological Worker I training (AL-162) provides basic radiation safety and protection concepts, contamination control techniques, proper personal protection equipment selection and use.

Radiological Worker II – Radioactive Material Users (AL-077)

Individuals who use radioactive materials require a basic understanding of ionizing radiation, its potential hazards and protection concepts as well as knowledge of the

particular rules and regulations governing radioactive material use. Radiological Worker II (AL-077) is provided to workers seeking authorization for use of radioactive material.

Radiological Worker II - Radiation Generating Devices (AL-076)

Individuals who use radiation generating devices (RGDs) require a basic understanding of ionizing radiation, its potential hazards and protection concepts as well as knowledge of the particular rules and regulations governing RGDs. Radiological Worker II (AL-076) is provided to workers authorized to use RGDs.

Radiation Survey Instrument Training (AL-157)

The HPG instructs radiological workers on the proper operation and use of radiation survey instruments provided at Ames Laboratory. This hands-on instruction is provided as soon as possible after personnel complete the RW II training specified above.

General Employee Radiological Training (AL-074)

General Employee Radiological Training provides methods for maintaining exposures to radiation and radioactive materials ALARA and is required for personnel who are not required to complete Radiological Worker II training but who may enter a controlled area and encounter radiological barriers, postings, or radioactive materials.

9.0 PERSONNEL EXPOSURE (Subpart C, Subpart E)

The radiation safety program has as a primary goal the maintenance of all personnel radiation exposures below regulatory limits and ALARA. Policy, Plans and Procedures are in place to facilitate 10 CFR 835 requirements. *ALARA* (Policy 10202.001) establishes an annual administrative control level of 0.5 rems based on historical personnel radiation dosimetry records, current activities, and projected activities involving sources of ionizing radiation at the Ames Laboratory.

The *External Dosimetry Technical Basis Document* (Plan 10202.005) provides information related to the scientific and technical basis for the external radiation dosimetry program and provides guidance for the assignment of specific external dosimetry type based on radiation exposure conditions. The HPG is responsible for implementation of the external dosimetry program. The external dose monitoring program demonstrates compliance with the dose limits established in subpart C based on the dosimetry provider's accreditation with the National Voluntary Laboratory Accreditation Program for Personnel Dosimetry, as Ames Laboratory has been granted an exception by the DOE to the DOELAP accreditation requirement.

The *Internal Dosimetry Technical Basis Document* (Plan 10202.001) provides the methods and rationale supporting the Ames Laboratory internal dosimetry program. Under typical conditions at the Laboratory, radiological workers are not likely to receive a committed effective dose of 0.1 rem or more from all occupational radionuclide intakes. The occurrence of a measurable intake of radioactive material and the potential for internal exposures at Ames Laboratory are extremely unlikely and the Laboratory's work with radioactive materials does not support establishment and maintenance of a routine bioassay program at Ames Laboratory. However, a contingency plan for obtaining bioassay measurements is maintained with Argonne National Laboratory.

Occupational Dose Limits

Current limits for occupational radiation exposure have been established at levels which, in light of present knowledge, will: (1) prevent all acute radiation effects (e.g. erythema, epilation); and (2) limit the risks of late effects such as cancer or genetic damage to very low, "acceptable" levels. These limits are established in 10 CFR 835. Annual occupational dose limits for adult radiological workers, are listed below (Table 1).

TABLE 1 Annual Occupational Dose Limits for Radiological Workers

Limit	rem	Sievert (sv)*
Shallow Dose Equivalent, Skin of the Whole-body	50 rem	0.5 sv
Shallow Dose Equivalent, Max., extremity	50 rem	0.5 sv
Eye Dose Equivalent to Lens of the Eye	15 rem	0.15 sv
Total Organ Dose Equivalent	50 rem	0.5 sv
Total Effective Dose Equivalent	5 rem	0.05 sv

*sievert is the S.i. dose equivalent unit (1rem = 0.01 sievert).

In addition, internal exposure limits are addressed through the establishment of "annual limits on intake" (ALI). These values represent the derived limit for the amount of radioactive material taken into an adult body by inhalation or ingestion in a year (in either single or multiple events) that would result in the individual receiving a committed effective dose equivalent of 5 rem or a committed dose equivalent of 50 rem

Determination of Compliance for Non-uniform Exposure of Skin (Subpart C 835.205)

For non-uniform exposures of the skin from X-rays, beta radiation, and/or radioactive materials on the skin are assessed according to the specification in 835.205.

Regulatory Dose Limits for Declared Pregnant Workers (Subpart C 835.206)

A declared pregnant worker is a woman who has voluntarily declared to her employer, in writing, her pregnancy for the purpose of being subject to the occupational dose limits to the embryo/fetus as provided in 835.206. This declaration may be revoked, in writing, at any time by the declared pregnant worker. The regulations only apply when a worker voluntarily declares her pregnancy in writing. If a declaration of pregnancy is made, the worker grants consent to her employer to limit her dose to a Total Effective Dose (TED) of 500 mrem throughout the entire pregnancy. If no declaration is made to the employer, her occupational dose limits are not restricted. A *Declaration of Pregnancy* (Form 10202.008) is made to the radiation safety officer and noted by the ALARA committee.

Occupational Dose Limits for Minors (Subpart C 835.207)

The dose limits for minors (anyone under 18 years of age) occupationally exposed to radiation at a DOE activity are 0.1 rem (0.001 Sv) TED in a year and 10 percent of the occupational dose limits specified at 835.202(a)(3) and (a)(4).

Dose Limits for Dose to Members of the Public (Subpart C 835.208)

The limits for dose to non-radiation workers and members of the public are generally two percent of the annual occupational dose limits. For the whole body dose, this would equal a TED of 100 mrem/year.

10.0 PERSONNEL MONITORING (Subpart E)

A number of devices and methods exist for assessing an individual's exposure from ionizing radiation. Whether or not one or more of these personnel monitoring methods is employed for a given situation will depend upon a number of factors (e.g. type and quantity of radioactive material used, amount of time spent working with the material, etc.), which together determine the particular exposure potential. An *External Dosimetry Technical Basis Document* (Plan 10202.005) provides the methods and rationale supporting the Ames Laboratory external dosimetry program. It includes guidance for monitoring individual exposures to external radiation and selection of personnel dosimeters. An *External Dosimetry* procedure (Procedure 10202.036) provides additional instructions to HPG regarding the operation of an external dosimetry program, and includes information regarding issuance, distribution, collection, and termination of badges, reporting of results, lost badge situations, and ALARA reviews.

Personnel Dosimeters

10 CFR 835 requires that any individual who is likely to receive more than 100 mrem annual occupational dose be monitored for radiation exposure. At Ames Laboratory there are two commonly used dosimeters, the whole body dosimeter and the ring dosimeter or extremity dosimeter. Ring dosimeters are required in research laboratories where x-ray systems are used. In order for a dosimeter to provide an accurate indication of an individual's dose, it must be worn properly; therefore instructions on dosimetry usage and wear cycle are given during initial issuance of dosimetry and during normal retrain cycles. For assessing whole body doses, the dosimeter should be worn on some area of the torso such as a breast pocket, lapel, or belt. Ring dosimeters should be worn with the sensitive surface toward the source of the emitting radiation, whether it is radioactive materials or RGDs, and it should be worn beneath gloves during procedure that require personal protective equipment.

Personnel Exposure Records/Reports (Subpart H, Subpart I)

10 CFR 835 requires monitoring of radiation workers who are likely to receive 100 mrem of annual occupational dose in the course of normal job duties. These personnel monitoring results are reviewed by the HPG to assure that radiation doses are ALARA. Doses that exceed the Ames Laboratory 100 mrem/year, whole body, are reviewed and investigated by the ALARA committee or their designee, the RSO. HPG notifies an individual immediately whenever current monitoring results exceed what is reasonably expected.

10 CFR 835 also requires that annual reports of occupational doses be given to those individuals meeting this monitoring requirement. Monitored personnel receive an annual occupational dose report and a report upon request by an individual following the provisions of the Privacy Act (5 U.S.C. 552a). Information on a person's radiation exposures is only released to the person directly or to a specified party authorized by the monitored individual. Data on non-occupational exposures are not collected, stored or reported by Ames Laboratory. A permanent record is kept on file of this release information, dated and signed by the individual involved. HPG maintains the results of all radiation personnel monitoring on file and archived records are stored with Official Personnel Files (OPFs) and Employee Medical Records (EMRs) in accord with the Laboratory's *Vital Records Plan* (Plan 48202.001).

11.0 LABORATORY SAFETY

The potential hazards associated with working with radioactive materials and radiation generating devices can be minimized through the use of appropriately designed and constructed facilities and by adherence to standard safety rules and practices. The Ames Laboratory *Integrated Safety Management System (ISMS) and Worker Safety and Health Program Description* (Plan 10200.016), and the *ESH&A Program Manual* (Manual 10200.002) document the primary elements of the Ames Laboratory's safety program.

11.1 Facility Requirements

The majority of research laboratories at Ames Laboratory can be classified as chemical laboratories. In most cases, these laboratories are adequate for the use of radioactive materials. For certain types and uses of radioactive materials, however, additional facility requirements must be met. The HPG determines the specific requirements.

In general, the following are minimum facility requirements for use of radioactive materials:

- Floors must have smooth, nonporous, easily cleaned surfaces. Appropriate floor materials include vinyl, tile, and sealed concrete.
- Benches must have nonporous, easily decontaminated surfaces, preferably made of high quality plastic laminate or stainless steel.
- Sinks should be stainless steel or have seamless molded construction.
- Hoods (when required) must be currently tested and certified by the ESH&A office, preferably constructed of stainless steel or molded fiberglass construction. Airflow rates, measured at the hood front opening must be a minimum of 100 linear feet per minute (+/- 20fpm).
- Shielding shall be provided when appropriate (e.g. for laboratories using large quantities of gamma or high energy beta emitting radionuclides). HPG will determine specific requirements on a case-by-case basis.
- A "Caution-Radioactive Material" sign must be conspicuously posted at each entrance (e.g., near or on the door) of a radionuclide laboratory. Such signs or labels shall also be affixed at locations within the laboratory where radionuclide are used or stored (e.g., hoods, refrigerators, microwave ovens, etc.).

11.2 Facility Audits and Radiation Surveys

The HPG conducts periodic inspections of radionuclide laboratories. Controlled areas are inspected quarterly. Radiation generating devices are surveyed annually. During the course of each inspection, both external radiation levels and surface contamination levels may be monitored. The activity supervisor's radionuclide inventory and contamination survey records may also be reviewed during inspections. Any problems encountered during the inspections will be discussed with the activity supervisor and, when necessary, with the group leader. A written report will be supplied to the group leader for all inspections where corrective actions are deemed necessary.

The *Control of Radioactive Contamination* procedure (Procedure 10202.008) provides an acceptable methodology for establishing and implementing a contamination control and measurement program. Conformance with this procedure demonstrates compliance with the related regulatory requirements. Alternate methods that are demonstrated to provide an equivalent or better level of protection are acceptable. Ames Laboratory's contamination control program incorporates three types of control: (1) design control, (2) engineering control, and (3) administrative control. Contamination measurements (survey and monitoring) process are also outlined in this procedure, in support of the contamination control program.

The *Quarterly Radiological Surveys* procedure (Procedure 10202.055) provides step-by-step instructions for performing the quarterly survey of controlled areas and radioactive material use areas to ensure effective contamination control. *Conducting Radiological Surveys* (Procedure 10202.060) provides guidance on the performance of radiological surveys and requires:

- smear surveys conducted by HPG on a monthly basis in active radioactive materials laboratories,
- annual scatter and leakage surveys conducted by HPG in radiation producing devices laboratories,
- surveys by HPG when new and significantly higher activity sources are received,
- surveys by HPG when radioactive material storage areas are relocated,
- surveys by HPG when radioactive waste containers are relocated,
- surveys by HPG when activity levels of radioactive material are changed significantly, and
- surveys by HPG when major renovation is conducted in areas that are suspect for legacy contaminations.

Prior to conducting an instrument survey, the following steps are required to ensure that the survey instrument is operating properly:

- perform a physical inspection of the instrument, checking for obvious physical damage,
- verify that the instrument has been calibrated in the last twelve months,
- perform a battery check to verify that the condition of the batteries is within acceptable limits,
- perform a response check to determine if the instrument is within ±10% of the normal response to a check source, if available, and
- ensure that the audio is working if the meter has audio capability.

The *Sealed Radioactive Source Accountability and Control* procedure (Procedure 10202.015) establishes the requirements and actions necessary to control sealed radioactive sources. The procedure establishes a semi-annual accountable sealed radioactive source inventory by the HPG and a required leak tests on accountable sealed sources.

12.0 RADIOACTIVE MATERIAL

The following information applies to groups that use, handle, or store radioactive materials and employees who transfer, ship, or receive radioactive materials.

Procurement

In order to ensure control of the types and amounts of radioactive materials and radiation generating devices, all purchases of these materials must be approved and processed by the ESH&A office. The procedure by which radioactive material may be ordered is as follows:

- The activity supervisor (or their designee) initiates the procurement process by contacting the ESH&A office concerning the proposed order.
- The ESH&A office reviews all orders of radioactive material to check that the researcher / group leader placing the order is authorized for the material and to guarantee that categorization 3 threshold limits (DOE-STD-1027-92, Table A.1) are not exceeded.
- The ESH&A office checks the type and amount of the radionuclide to be ordered against that which the user is authorized. If under the laboratory's limit and the groups limit, then the ESH&A office authorizes the order.
- A log number for the order is assigned.
- The vendor must be instructed to reference one or more of the following on the packing slip accompanying the order:
  - name of the activity supervisor
  - name of the person who placed the order
  - log number assigned to the order

The vendor must also be instructed to send the shipment to the receiving address: Ames Laboratory - DOE Warehouse, Attn: ESH&A, HP Group, ISU Campus, 2405 Kooser Drive, Ames, Iowa 50011-3020

Receipt and Delivery of Radioactive Material (10 CFR 835 Subpart E 835.405)

Receipt, Transfer, & Shipment of Radioactive Materials (Procedure 10202.014) provides guidance for the requirements in 10 CFR 835 and 49 CFR 171-173 related to receipt, and transfer of radioactive materials. When packages containing quantities of radioactive material in excess of a Type A quantity (as defined in 10 CFR 71.4) are received by the Ames Laboratory, arrangements are made to either (1) take possession of the package when the carrier offers it for delivery, or (2) notify the HPG as soon as practicable after arrival of the package at the Ames Laboratory Warehouse so that HPG personnel can take possession of the package expeditiously.

Procedure 10202.014 also provides guidance for the safe opening of packages containing radioactive materials. Upon receipt of a radionuclide shipment, the HPG staff checks the package and its contents for contamination and to ensure that any existing radiation levels are within the regulatory requirements. HPG staff then records the type and amount of the radionuclide received into its radioactive material accountability system. The package is delivered once the HPG package receipt process is completed.

Security, Storage and Transfer of Radioactive Materials (Subpart F 835.501(d), Subpart K 835.1001(d), 835.1003)

The following guidance applies to security, storage and transfer of radioactive materials.

Security of Controlled Areas: Security of controlled areas must be in place at all times. All locations where radioactive materials or sealed radioactive sources are present must be in constant attendance by the trained user, or secured to prevent unauthorized removal or tampering.

Storage of Radioactive Materials: Storage of radioactive materials shall be in secured or locked cabinets, refrigerators, freezers or waste areas, unless attended by the user. Radioactive materials should be stored in sealed containers in such a way as to prevent accidental spillage or breakage, and to prevent release into the air. If the nuclide requires shielding, it should be stored in shielded containers in order to prevent doses to personnel accessing the storage areas. If the radioactive material has been stored in a freezer, the material shall be thawed, opened and handled in a fume hood or biological safety cabinet. Aerosols from stored radioactive materials may cause contamination of adjacent areas and doses to personnel if not handled in the proper way after storage. All radioactive materials, whether in storage, waste or use, should be labeled with the radioactive warning symbol, the words "Caution, Radioactive Materials," at the minimum, the isotope, the date and the amount of radioactivity in dpm or microcuries.

Transporting Radioactive Material: Requirements for the transport of radioactive material at Ames Laboratory and to other institutions must take place in accordance with U.S. Department of Transportation (DOT) regulations (49 CFR) and the Ames Laboratory procedure *Receipt, Transfer, & Shipment of Radioactive Materials* (Procedure 10202.014). Procedure 10202.014 provides guidance for the requirements in 10 CFR 835 and 49 CFR 171-173 related to receipt, and transfer of radioactive materials. The ESH&A office must be notified before any transport takes place to ensure that proper procedures are followed and movement of radioactive material is tracked. The Ames Laboratory *Transportation Safety Manual* (Manual 48303.001) provides guidance and delineates responsibilities among Materials Handling Services, the Packaging and Transportation Services Manager, HPG, and the request for transportation of radioactive materials.

Package Preparation: Containers used to transport radioactive material must be acceptable packaging as defined in 49 CFR, and that will not leak under normal transportation conditions (such as, dropping or jarring). Ames Laboratory Material Handling office must approve all shipping containers.

Local Transfers of Materials (ownership and physical movement): Approval of a transfer of radioactive material between individuals at Ames Laboratory will depend primarily upon two things; 1) Whether the individual who wishes to receive the material has been authorized for the radioactive material involved; and 2) whether the individual has received authorization for the specific procedure(s) related to the usage material. Should the proposed recipient for the material not be currently authorized for the material use, he or she may submit an application requesting authorization. Only after authorization by the ALARA committee will the ESH&A office approve the transfer of material. If the hazard significantly changes the researcher activity the readiness review file will have to be reviewed and approved by the SRC.

Moving Materials to another Building: When moving (walking) radioactive material to another building, the worker must use an appropriate container (see packaging above). The outside of the package must have a radioactive warning label with the following information: the isotope, activity level, and date.

Transporting Materials via Motor Vehicle to another Building: The transportation of radioactive material must be done in accordance with the requirements of the U.S. Department of Transportation (DOT). Materials cannot be moved by personal vehicle. The Material Handing Office and ESH&A will assist in the necessary documentation and packaging, and perform the actual transport of the material.

Off-Site Shipments: When preparing to ship radioactive material off-site, whether it is radioactive samples or a piece of equipment being returned for repairs, Material Handling and ESH&A must be informed in advance. Approval of a shipment of radioactive material off-site will depend primarily upon whether the proposed recipient has appropriate authorization to possess and use the material. Once Material Handling and the ESH&A office approve the shipment, materials handling staff will then procure the proper packaging for the material. Materials handling will determine what package labeling is required. If required, a radiological survey will be conducted prior to shipment by HPG. Copies of the shipping papers and any other paperwork will be completed and retained on record in the Material Handling office.

Minor Spills

Incidents involving the release or spillage of less than 100 microcuries of a radionuclide in a nonvolatile form can generally be regarded as minor. In such cases:

1. Notify all other persons in the room at once.
2. Clear the room of all persons except those needed to deal with the spill.
3. Confine the spill immediately.
   - Liquids: Drop absorbent paper or chemical (e.g. calcium bentonite) on the spill. Standard "Spill Control Kits" are located in the first aid lockers throughout Ames Laboratory spaces.
   - Solids: Dampen thoroughly, taking care not to spread contamination. Use water, unless a chemical reaction would release air contaminants; otherwise use oil.
4. Notify the activity supervisor.
5. Notify the ESH&A office (phone: 4-2153)
6. After hours, notify the Plant Protection Section (phone: 4-3483).

Major Spills or Releases

An incident that occurs outside of the hood and involves the release of more than 100 microcuries of a radionuclide in a nonvolatile form, or the release of any amount of a radionuclide in a volatile form, should be considered "major." In such cases:

1. Evacuate the room immediately shutting doors and windows on the way out.
2. Notify the laboratory supervisor.
3. Notify ESH&A (4-2153), after hours, notify the Plant Protection Section (4-3483).
4. Post the laboratory doors with a “Keep Out” sign.
5. Assemble those persons who were present in the laboratory near the entrance.
6. Wait for assistance.

Accidents Involving Personal Injury

For accidents involving personal injury, medical treatment or assistance will always be the first priority. This may involve administering first aid and/or calling 911 for emergency medical assistance. For accidents involving radioactive materials, contamination control and exposure are also important but should never delay or impede medical assistance. ESH&A must be notified as soon as possible.

Decontamination Procedures

Despite the strict adherence to all laboratory safety rules, it is possible that accidents involving radioactive material may occur. It is important that radioactive material users are aware of the proper procedures to follow for various types of accidents. If the decontamination is minor in nature (i.e., cleaning a table-top, small tools, etc.), the user is authorized to do these decontamination operations. Laboratory radiation detection instrument should be used to locate the contamination. After cleanup is done HPG should be contacted to request verification that the area is free of contamination and to dispose or radioactive waste generated from the decontamination. For larger areas or equipment, HPG should be contacted to assist with the decontamination. For most relatively minor contamination incidents, the following general steps should be taken upon discovery of the contamination:

1. Mark the perimeter of the contaminated area.
2. Notify HPG of the contamination for a more thorough assessment of the extent of the contamination, for advice and assistance in the decontamination effort.
3. Assemble cleaning supplies such as paper towels, detergent in water, plastic bags and plastic gloves.
4. Proceed with scrubbing the area from the borders to the center, cleaning small areas at a time.
5. Periodically monitor the effectiveness of the decontamination effort with surface wipes and instrument surveys (see Table 2 for contamination limits).
6. Place all contaminated cleaning materials such as paper towels, rags, and gloves in a plastic bag and label as radioactive waste.
7. Notify HPG upon completion of the decontamination effort so that a follow-up contamination survey can be conducted.

Table 2. Limits of Radioactive Contamination on Surfaces or Items to be Released for Unrestricted Use *[Taken from Appendix D to Title 10, Code of Federal Regulations, Part 835—"Surface Radioactivity Values"--except for portions on Direct Measurements.]*

The data presented in the following table are to be used in identifying contamination and high contamination areas as defined in 10 CFR 835.2(a), identifying the need for surface contamination monitoring and control in accordance with 10 CFR 835.404, identifying the need for radioactive material controls in accordance with 10 CFR 835.1101.

RADIONUCLIDE OR TYPE OF RADIATION	**REMOVABLE. By use of smears of the surface [2,4]**	**TOTAL (Fixed + Removable). By use of smears and/or direct [9] measurements [2,3]**
U-nat, U-235, U-238, and associated decay products.	1,000 dpm/100 cm^2 (alpha)	5,000 dpm/100 cm^2 (alpha)
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227,I-125, I-129.	20 dpm/100 cm^2	500 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133.	200 dpm/100 cm^2	1,000 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above. [5]	1,000 dpm/100 cm^2	5,000 dpm/100 cm^2
Tritium and tritiated compounds. [6]	10,000 dpm/100 cm^2	N/A
Alpha	N/A	(Using Survey Instrument) Non-detectable [7]
Beta/Gamma	N/A	(Using Survey Instrument) 0.1 mR/hr @ 1 inch [8]

[1] The limits in this Table, with the exception noted in footnote 6, apply to radioactive contamination deposited on, but not incorporated into the interior of, the contaminated item. Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides apply independently.
[2] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.
[3] The levels may be averaged over one square meter provided the maximum surface activity in any area of 100 cm^2 is less than three times the value specified. For purposes of averaging, any square meter of surface shall be considered to be above the surface radioactivity value if: (1) from measurements of a representative number of sections it is determined that the average contamination level exceeds the applicable value; or (2) it is determined that the sum of the activity of all isolated spots or particles in any 100 cm^2 area exceeds three times the applicable value.
[4] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by swiping the area with dry filter or soft absorbent paper, applying moderate pressure, and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. (Note - The use of dry material may not be appropriate for tritium.) When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area shall be based on the actual area and the entire surface shall be wiped. It is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.
[5] This category of radionuclides includes mixed fission products, including the Sr-90, which is present in them. It does not apply to Sr-90, which has been separated from the other fission products, or mixtures where the Sr-90 has been enriched.
[6] Tritium contamination may diffuse into the volume or matrix of materials. Evaluation of surface contamination shall consider the extent to which such contamination may migrate to the surface in order to ensure the surface radioactivity value provided in this appendix is not exceeded. Once this contamination migrates to the surface, it may be removable, not fixed; therefore a "Total" value does not apply.
[7] Non-detectable is a reading less than the average instrument background plus 10%.
[8] Reading from a survey instrument with the beta shield open and a maximum distance of 1 inch from the surface of the detector tube to the surface being monitored.
[9] Direct measurements are of the total fixed + removable contamination and recorded in dpm/100 cm^2 if an E-perm device is used or recorded in mR/hr if a standard radiation survey instrument is used.

13.0 RADIATION GENERATING DEVICES (RGD)

The following requirements are promoted in consideration of the radiation safety guidance specified in American National Standards Institute (ANSI) Standard N43.2, "Radiation Safety for X-ray Diffraction and Fluorescence Analysis Equipment", as well as ANSI N43.3 and referenced standards therein.

Procurement

All purchase requests for RGDs must be approved by ESH&A. New RGDs must go through Readiness Review just as any new research activity process at Ames Laboratory would. The Readiness Review process and the ALARA committee approval must be completed prior to normal operation. Upon first use, ESH&A, HPG will conduct a survey to verify safe operating conditions surrounding the unit, which will also be added to the annual audits and quarterly inspections schedule.

Security of Controlled Areas

Security of controlled areas must be in place at all times. All locations where radioactive materials or radiation generating devices are present must be in attendance by the trained user, or secured to prevent unauthorized removal or tampering.

Transferring Ownership of Radiation Generating Devices

Transfers of RGDs must be pre-approved by the RSO. If the equipment is changing ownership or if deemed necessary for increased hazard concerns, the process may be subject to readiness review and ALARA committee approval.

Standard Requirements for RGD Areas

One or more of the following features shall be employed for each entrance or access point to a high radiation area, (i.e., the area immediately around the x-ray port) where radiation levels exist such that an individual could exceed a deep dose equivalent to the whole body of 0.1 rem (0.01 sievert) in any one hour at 30 centimeters from the source or from any surface that the radiation penetrates:

- A control device that prevents entry to the area when high radiation levels exist or upon entry causes the radiation level to be reduced below that level defining a high radiation area;
- A device that functions automatically to prevent use or operation of the radiation source or field while individuals are in the area;
- A control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the high radiation area and the supervisor of the activity are made aware of the entry;
- Entryways that are locked. During periods when access to the area is required, positive control over each entry is maintained;
- A control device that will automatically generate audible and/or visual alarm signals to alert personnel in the area before use or operation of the radiation source and in sufficient time to permit evacuation of the area or activation of a secondary control device that will prevent use or operation of the source.

10 CFR 835 requires that personnel dosimetry shall be provided to and used by individuals entering a high or very high radiation area. In the case of x-ray systems, high and very high radiation areas could be encountered at or near the x-ray port, therefore, ring dosimetry must be worn at all times when operating these systems.

The primary objective in devising and implementing x-ray system control measures is minimizing the potential for radiation exposure, especially from the primary x-ray beam. Ames Laboratory requires that all x-ray generating systems be operated only in approved areas. The following are standard requirements for Ames Laboratory x-ray system usage areas.

Posting and Labeling for RGDs

Entry doors to x-ray laboratories shall be posted with “Caution Radiation Generating Device” signs. X-ray housing shall be posted with “Controlled Area” labels or postings. A radiological buffer area (RBA) boundary shall be established around each x-ray system in a laboratory, and the RBA shall have the same boundaries as the physical interlocked barrier around each system. The RBA will limit access to those personnel who are properly trained and who require entry for purposes of using the x-ray system. X-ray generating equipment shall be labeled near switches which energize an x-ray tube with a sign bearing the radiation symbol and the words, “Caution: This Equipment Produces X-rays When Energized”, or words of similar meaning.

Non-essential equipment

Equipment not utilized in x-ray experiments should not be located within the same room. If it is impractical to relocate such equipment, operation of the equipment shall be minimized as much as practical and shall in no case interfere with the safe operation of x-ray equipment in the room. Personnel who work in the same room in which an x-ray system is located are not authorized to enter the radiological buffer area to conduct activities and must complete General Employee Radiological Training (AL-074), since working near a controlled area.

Instrumentation

There should be a radiation detection instrument of the appropriate energy response located in the immediate working area of all x-ray systems. Group leaders should ensure that periodic checks are made near the x-ray system to detect stray radiation. Before use checks, also called operational checks, should be conducted to ensure the instrument is functioning properly. HPG will provide the instruments and ensure instruments are calibrated annually.

Radiological Surveys

Radiation surveys of RGDs are conducted by HPG prior to normal operation after initial installation and annually thereafter. A survey is also required after major maintenance and when substantial modifications to the x-ray system are made. Users are required to conduct a radiation survey on occasions when the system is placed on an off-normal state such as when the interlocks are bypassed.

System Barrier

All open beam x-ray systems shall have an enclosure housing and accessory equipment enclosure that meets all of the requirements of ANSI N43.2 and shall be interlocked such that all shutters will close if access doors are opened, unless the interlock is consciously defeated. Entryways should be locked or controlled during off normal states of x-ray systems such as a bypassed interlock.

Multiple X-ray Systems within a Single Laboratory

When two or more x-ray systems are located within a single laboratory and are not part of the same experiment, the systems must be setup in such a way that the systems may be independently and simultaneously operated as if each were in its own laboratory. Specifically, primary x-ray beams and leakage radiation shall be confined to within a single experimental area. All x-ray systems within one controlled area may be located in the same RBA, if practical.

Specific Hazard Awareness

X-ray system supervisors or group leader must not permit operation of a new or modified x-ray under their authority without making personnel aware of the potential hazards associated with the use of each type of system in their area. X-ray system specific training is required for all user of each respective system.

Standard Operating Procedures

Standard operating procedures (SOPs) are required for x-ray system operations. Procedures should address normal operation and off-normal operations if such exist, (e.g., by-passing of interlocks). Procedures for by-passing interlocks must include: radiation protection precautions, dose reduction methods, dosimetry and monitoring requirements. Radiation monitoring must be performed while working with a by-passed interlocked system. Manufacturer's instructions/manuals for by-passed interlocks can supplement and in some cases serve as the procedure if approved by the RSO.

Records (10 CFR 835 Subpart H)

Required records that should be maintained by system custodians include: training, system users, system use and records of maintenance on the system. These records may either be kept in separate books ("User Logbook" / "Maintenance Logbook") or can be combined and kept in one booklet in separate sections. Computerized records are authorized and shall be readily retrievable, accurate and appropriately archived.

14.0 SEALED RADIOACTIVE SOURCES (Subpart M)

A sealed radioactive source means a radioactive source manufactured, obtained, or retained for the purpose of utilizing the emitted radiation. The sealed radioactive source consists of a known or estimated quantity of radioactive material contained within a sealed capsule, sealed between layer(s) of non-radioactive material, or firmly fixed to a non-radioactive surface by electroplating or other means intended to prevent leakage or escape of the radioactive material. Sealed radioactive sources do not include reactor fuel elements, nuclear explosive devices, and radioisotope thermoelectric generators.

An accountable sealed radioactive source means a sealed radioactive source having a half-life equal to or greater than 30 days and an isotopic activity equal to or greater than

the corresponding value provided in Appendix E of 10 CFR 835.

In order to ensure control of the types and amounts of sealed radioactive materials entering Ames Laboratory, all purchases of these materials are approved and processed by ESH&A. HPG reviews and approves all sealed radioactive sources activities via the readiness review process which involves the ALARA committee and final approval by SRC. It is the responsibility of the end user of a sealed source to maintain the use in accordance with the ALARA policy.

Specific procedures are required before removing sealed sources from its normal shielding configuration. Radiation protection precautions, dose reduction methods, dosimetry and monitoring requirement must be identified in procedures for off-normal states, e.g., removing a source from its shielded configuration. Procedures are required while using a sealed radioactive source during off-normal states capable of generating external radiation fields in excess of 100 millirem/hour at 30 cm. Radiation monitoring must be performed while working with a sealed source out of is shielded configuration. Manufactures instructions/manuals for handling sources can supplement and in some cases serve as the documented procedures, if approved by the RSO.

Sealed Radioactive Source Accountability and Control (Procedure 10202.015) establishes the requirements and actions necessary to control sealed radioactive sources. The HPG is responsible for implementing this procedure by maintaining a source database, performing decay corrections to identify sources that are no longer accountable, performing a semi-annual accountable sealed radioactive source inventory, performing the required leak tests on accountable sealed sources, isolating sources that fail the leak test, and ensuring that each group that uses sealed sources appoints a source custodian responsible for the physical control of assigned sources. The procedure also addresses procurement, receipt and delivery, inventory frequency, leak test requirements, and transferring of sources. Records are maintained by the RSO or HPG to demonstrate compliance, including inventories and source leak testing.

15.0 POSTING and LABELING for RADIOLOGICAL CONTROL (Subpart G)

The goal of a radiological posting and labeling program is to identify and effectively communicate radiological hazards to individuals, allowing them to take the appropriate protective actions. A uniform system of posting and labeling for radiological control is essential to alert personnel to the presence of ionizing radiation or radioactive material in order to assist individuals in maintaining exposures ALARA. 10 CFR 835 requires that certain areas and items be posted or labeled to control personnel exposure to radioactive material and ionizing radiation and to prevent the spread of contamination. 10 CFR 835 also provides exceptions to the posting and labeling requirements under certain circumstances and, when implemented, apply to posting or labeling only and are not exceptions to entry control requirements.

All postings for radiation protection purposes are managed by HPG. The *Posting and Labeling for Radiological Control* procedure (Procedure 10202.016) provides guidance to ensure that radiological hazards are appropriately posted and labeled. The procedure provides an acceptable methodology for establishing radiological postings and labels. Ames Laboratory postings and labels utilize the standard radiation warning trefoil in black or magenta imposed upon a yellow background. Signs must be clearly and conspicuously posted. Postings can include protection instructions communicating area

radiation hazards. Areas are posted as controlled areas, where access is managed to protect individuals from exposure to radiation and/or radioactive material.

16.0 RADIATION WORK PLANNING for LEGACY CONTAMINATION (Subpart F, Subpart K)

Thorough process knowledge of historic research activities performed in some of Ames Laboratory's spaces and subsequent surveys, legacy radioactive contamination is known or suspected to exist. Some areas within Laboratory buildings have not been accessed or are not easily accessed which have not been characterized. These areas may need servicing and maintenance or need equipment/materials removed. These areas should be considered contaminated until a survey is conducted. Examples of the types of areas, materials, and equipment that may have legacy contamination are ductwork, drain lines, electrical conduits, fume hood exhaust ducts, areas between walls, inside wall block, and under floor tile, etc.

As a general rule, plans to perform work in Wilhelm Hall, Spedding Hall, Metals Development, and the Laboratory's support buildings on areas, equipment, or materials that have been in place prior to 1985, shall include notification of HPG. Special consideration is necessary for materials (purchased prior to 1985) in the construction storage sheds. Items that are either relocated from the building or scheduled to be disposed of will require a radiological clearance survey. Notification of HPG is required to schedule a review and clearance survey.

Through experience working in Ames Laboratory facilities, Facilities & Engineering Services personnel are aware of areas that have the potential for radioactive contamination. Fume hood air handling systems may contain radiological contamination in addition to other nonradioactive contaminants. Normal respiratory and protective clothing required by the radiological conditions provides protection, and dust control measures are required to keep exposure at a minimum as well as dust migration at a minimum. Facilities & Engineering Services personnel shall notify the HPG when work is pending in an area that could contain contamination.

The Laboratory has Radiological Work Permits (RWP) in place to cover F&ES activities (i.e., general RWPs and specific RWPs). When legacy contamination has been identified and work has been stopped as necessary, a Technical Work Document (TWD) should be prepared by an F&ES engineer. The TWD will be used by the RSO in preparation of a specific RWP, which will address the radiological work conditions and requirements for radiological protection necessary to complete the project. If the work is within the scope of existing RWPs, a specific RWP is not necessary.

The specific RWP for each area of legacy contamination, outside the scope of a general RWP, encountered will address: dosimetry requirements, pre-job briefings, training requirements for entry into areas, protective clothing and respiratory requirements, radiological control coverage requirements and stay time controls, confined space entry coverage requirements, limiting radiological conditions, and special personnel contamination checking considerations. For example, a specific RWP will be written to cover work performed when legacy contamination is found in a certain type of exhaust duct, in drainpipes or under floor tile in a building, etc. HPG and F&ES work closely during maintenance and/or demolition activities.

17.0 RADIOACTIVE WASTE MANAGEMENT (Subpart L)

Radioactive waste is any unwanted or discarded material, equipment or system component determined to be contaminated with radioactive materials, including solid, liquid, semisolid, or contained gaseous materials and therefore must be managed for its radioactive content. Materials used to handle radioactive waste must also be considered radioactive and handled accordingly. Accurate waste identification is essential to ensure handling and disposal is handled safely. HPG personnel perform analyses to determine radioactivity and isotopic content of a material if necessary. Ames Laboratory radioactive waste management activities are designed to protect the public from exposure to radiation from radioactive materials, protect the environment, protect workers, and comply with Federal, State and local laws and regulations. The Laboratory maintains a low-level waste storage room in B56A Spedding Hall, and a radioactive waste area (RWA) in room 105 of the Mechanical Maintenance Building. Refer to the *Waste Management Program Manual* (Manual 10200.003) for additional guidance related to radioactive waste management.

Radioactive Waste Handling

The ESH&A office is responsible for the collection, processing, and disposal of all radioactive waste generated at Ames Laboratory. A radioactive material management area (RMMA) is a designated location to store radioactive waste. Radiological material storage within these areas requires that procedures be followed to continue acceptable operation of the RMMA. Radioactive material users are required to follow specific procedures regarding radioactive waste generated in their laboratories:

- Radioactive waste should be separated and labeled according to whether it contains very short-lived (i.e. half-lives less than 15 days), short-lived (i.e. half-lives between 15 and 90 days) or long-lived (i.e. half-lives greater than 90 days) radionuclide.
- Solid radioactive waste must be separated and labeled according to whether it is combustible (e.g. plastics, paper, etc.) or noncombustible (e.g. glass, metal, etc.). Each of the waste containers required for this purpose should be lined with a plastic bag that must be removed and sealed when full.
- Sharp items such as needles and razor blades should not be placed in the solid waste container but should be placed in a cardboard box, glass bottle or "sharps" container. Lead source containers and source vials must also be held separately from other solid waste.
- Liquid radioactive waste should be separated and labeled according to whether it is aqueous (miscible in water) or organic. Organic liquids that are flammable (e.g. contain toluene or xylene) must be placed in containers specifically approved for flammable liquids. Since mixed waste contains both chemical and radioactive components, it shall be properly identified using the following definitions.
- Generation of mixed waste is not permitted without approval by ESH&A and DOE Ames Site Office. Full readiness review proceeding are required for activities that will or potentially generate mixed waste.
- Radioactive waste awaiting collection by ESH&A should be properly packaged labeled, and placed in a designated RMMA. Solid and liquid waste containers, plastic bags, and radioactive waste labels are supplied by the ESH&A office.

Radioactive waste labeling must include "CAUTION RADIOACTIVE WASTE". Radioactive waste collection is requested by calling ESH&A (4-9277, 4-2153).

- Protection from radiological hazards for workers, the environment, and public are in place for compactor operations at the RWA.
  - Engineering controls consist of interlocks that prevent the compactor from running unless the HEPA filtration system is operating, and the HEPA filtration system is equipped with a manometer.
  - A continuous air monitor is on the effluent end of the HEPA filtration system. The compactor is exempt from permitting per 567 IAC 22.1(2)w. This is documented and on file in ESH&A and at the RWA.
  - The manufacturer's standard operations procedure is read, signed by each qualified user, and filed in the readiness review folder and at the RWA.
  - Workers wear the appropriate PPE when conducting radioactive waste operations which includes work with the compactor.
  - Workers undergo radiological survey after radioactive waste operations.

Radioactive Waste Minimization

Employees are encouraged to develop processes to reduce the amount of radioactive waste generated. Waste minimization techniques could include:

- Periodically review procedures to ensure that unnecessary waste are not being generated. Use less radioactive material, recycle when possible, etc.
- Place only radioactive waste in the radioactive waste containers. Normal trash should be segregated and disposed of separately.
- Work on easily decontaminated surfaces (stainless steel trays or absorbent paper) to minimize the amount of waste generated from a small spill.
- Wash glassware and survey for contamination. Radioactive wash water should be placed in liquid waste containers.
- Material substitution - consider using non-radioactive methods.
- Substitute very short-lived isotopes whenever possible.
- Restrict all materials in radiological buffer areas to those needed for the work.

Radioactive Waste Management Basis

The Ames Laboratory Radioactive Waste Management Basis is documented in accordance with DOE Order 435.1, *Radioactive Waste Management* which establishes requirements for the management of radioactive waste at facilities operated by the Department of Energy (DOE) and its contractors. ESH&A has lead responsibility for radioactive waste operations at the Ames Laboratory. The *Radiological Waste Management Basis* (Plan 10200.033) defines low-level radioactive waste (LLW) and high-level or transuranic waste. The Laboratory does not have any high-level or transuranic waste in storage and does not foresee generating any of these types of waste. LLW is tracked by ESH&A in the Waste Tracking Database. The Laboratory ships its LLW offsite for disposal to another DOE facility whenever possible, and commercially approved disposal facilities are utilized when DOE facilities are not available or cost effective. Due to the small amounts of low-level waste generated at the present time it is not economically practical to ship on an annual basis. The Laboratory evaluates its LLW and determines if it is economically feasible to ship LLW with DOE concurrence.

Waste Management Contingency Plan

The Laboratory's *Waste Management Contingency Plan* (Plan 10200.017) details the actions that must be taken by the Incident Commander and Spill Response Team in the event of an emergency that involves the hazardous waste storage room (B55 Spedding Hall), the low-level waste storage room (B56A Spedding Hall), and room 105 in the Mechanical Maintenance Building (Radioactive Waste Area/RWA), and the events that may require the Spill Response Teams expertise. The contingency plan was established in accordance with 40 CFR 265.52.

Release of Material and Equipment (Subpart L 835.1101)

Processes for screening property ensure that radiological contamination control is maintained and the contaminate material and equipment is not released. The Laboratory's green tag program, documented in *Survey of Equipment/Material for Transfer to the Ames Laboratory Warehouse* (Procedure 10202.054), requires that property such as laboratory equipment including desks, chairs and laboratory components are scrutinized by the HPG and cleared based on survey results or process knowledge before release to the warehouse or elsewhere within the Laboratory.

18.0 EMERGENCY EXPOSURE SITUATIONS (Subpart N)

Ames Laboratory does not maintain an inventory of nuclear materials such that sufficient quantities of fissile material are present to potentially constitute a critical mass and activities are not present which could be expected to produce emergency exposure situations. Should the inventory of special nuclear materials be increased to potentially constitute a critical mass, Ames Laboratory will review and revise its RPP accordingly.

Emergency Exposure Situations (Subpart N 835.1302)

In the unlikely event of an emergency exposure event, the risk to individuals involved in rescue and recovery operations would be minimized through the application of ALARA principles during all levels of planning and execution, and individuals involved would be briefed beforehand on the known or anticipated hazards. No individual shall be required to perform rescue actions that might involve substantial personal risk. Planned special exposures will be specifically requested in writing to the appropriate DOE authorities responsible for environment, safety and health matters per 10 CFR 835.204 and approval received prior to any radiation doses incurred in excess of the limits specified in 10 CFR 835.202(a).

Nuclear Accident Dosimetry (Subpart N 835.1304)

The exposure of personnel to radiation from a nuclear criticality accident is not possible at the Ames Laboratory and personnel are not provided nuclear accident dosimetry and the Laboratory does not require the installation of criticality alarm systems.